104050300-TR0027 - R00

Steering Magnet Requirement for DTL, CCL and SRF --- a Summary

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7 Nov 2001

Introduction

Dipole steering magnets are needed to correct for the off-axis excursion of the beam in linac sections caused principally by quadrupole misalignments and input beam error. In the SNS linac, there are 24, 32, and 24 dipole correctors in DTL, CCL, and SRF respectively as listed in Table 1. We ran LTRACE code for 10,000 linacs with standard set of errors (presented to the September ASAC committee) to estimate the required dipole strength needed in the three different sections of the linac. Each of these runs, thus represents a linac with a specific set of random errors. LTRACE is an envelope tracking code that can incorporate the required set of errors in the linac and keeps track of the centroid motion in addition to the ellipse evolution. Required strength for each corrector dipole is recorded for each run. In the DTL, we use conventional steering technique while in the SCL and SRF we use "minimum steering" technique.

Summary

Figures 1 through 3 show the maximum and 3σ values for the G*L product for each dipole corrector in the DTL, CCL and SRF respectively out of the 10,000 values. Range for the highest of the maximum and 3σ values are also tabulated in Table1.

Table I. Dipole correctors

	DTL	CCL	SRF
No. of Dipole correctors	12(H)+12(V)	16(H)+16(V)	12(H)*+12(V)*
Max. value Range (G-cm)	2250-1150	850-375	1700-1000
3σ value Range (G-cm)	1650-1050	700-300	1250-800

* Includes 11 low-β and 12 high-β active cryo-modules; Total count to the end of linac i.e., up to the interface between the 'nominal' end of linac and start of HEBT is 16 (H) plus 16 (V).

A field of 2169G-cm was measured in the prototype DTL dipole with a current of 270A. A current of 295A from the power supply should then yield a field of 2370 G-cm. From Fig.1, the first and the second dipoles of the DTL require fields that are over 2000G-cm. For the first DTL dipole, 3σ value for the G*L is 1650 G-cm. This means that there is 99.7% probability that the required value will be within 1650 G-cm. Even for the very low-probability value of 2250 G-cm, a 295A current would provide a margin of 5%.
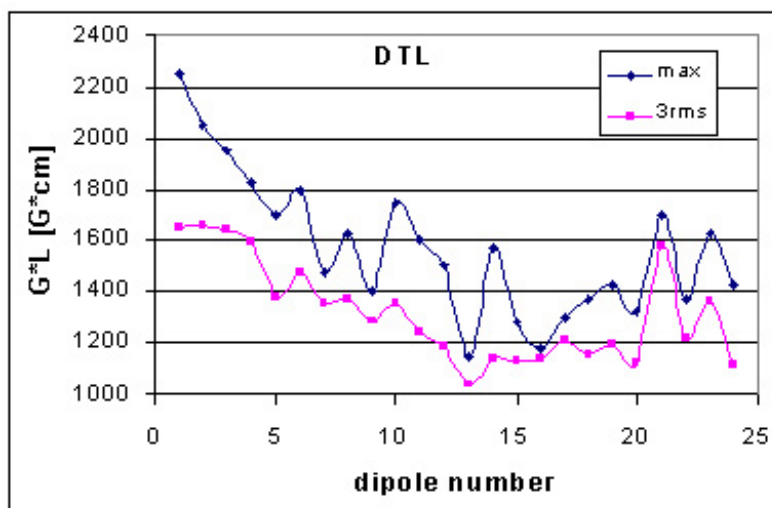
Figure 1. G*L values for the dipole correctors in the DTL.
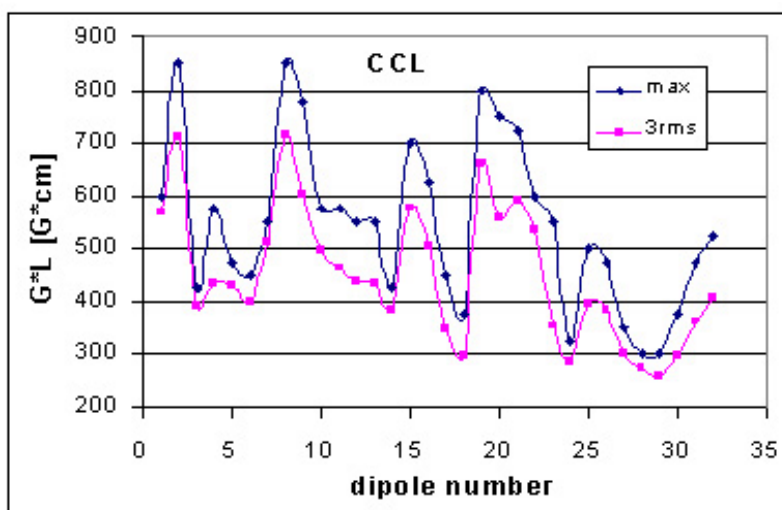
Figure 2. G*L values for the dipole correctors in the CCL.
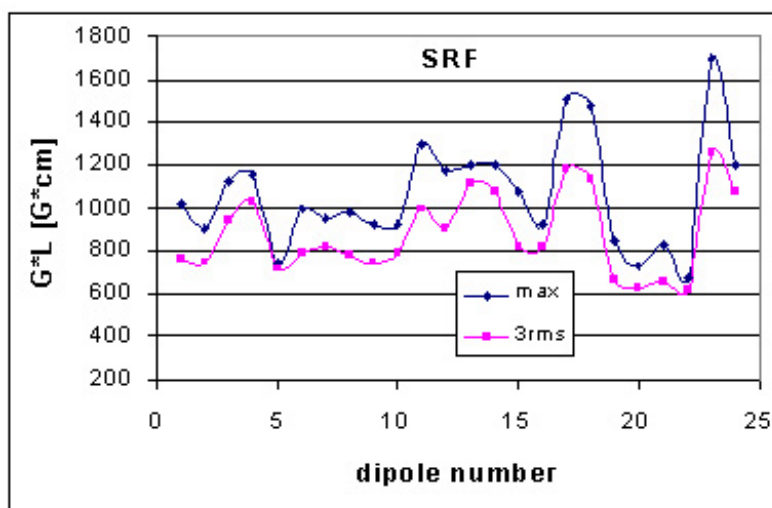
Figure 3. G*L values for the dipole correctors in the SRF.